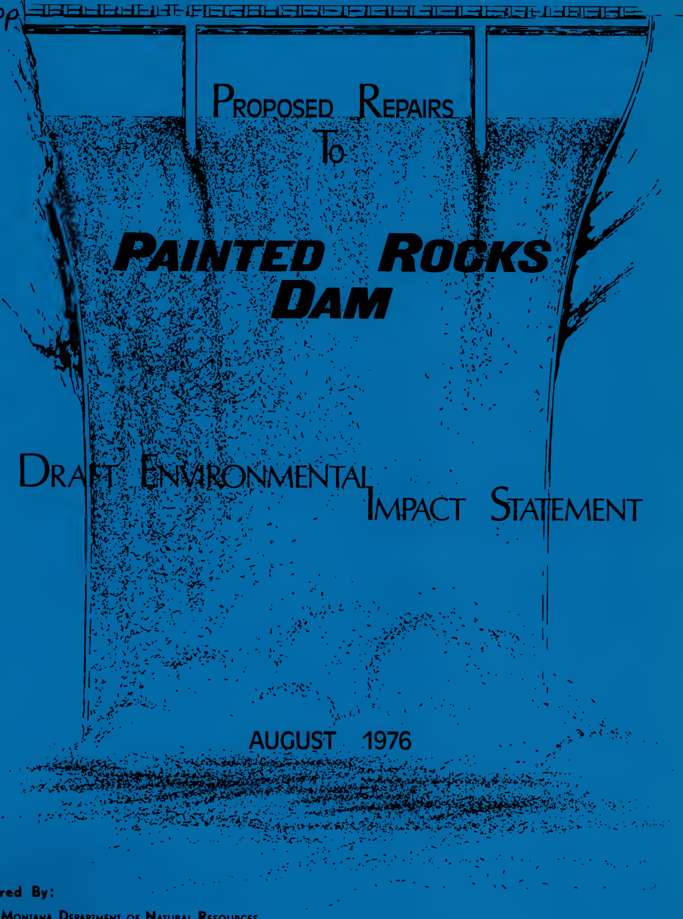

Proposed Repairs To Painted Rocks Dam

Draft Environmental Impact Statement

AUGUST 1976

Prepared By:

Montana Department of Natural Resources and Conservation

Water Resources Division

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

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August 7, 1976

Following is the Draft Environmental Impact Statement for the proposed repairs to the Painted Rocks Dam on the West Fork Bitterroot River. This action is proposed by the Water Resources Division, Department of Natural Resources and Conservation.

I would encourage you to carefully review this statement and invite your response. Any written comments should be submitted to me by September 7, 1976. In anticipation of the repairs commencing in October and due to the emergency nature of this proposed action, the fifteen-day comment extension period normally granted upon request cannot be accommodated. The normal 30-day comment period will allow the Final Environmental Impact Statement to be circulated before repair action would be commenced.

Finally, because drawdown of the reservoir is a lengthy process requiring several months, the drawdown has been initiated at this time to accommodate mid-October repair efforts.

This Draft Environmental Impact Statement was prepared in compliance with the Montana Environmental Policy Act, Section 69-6504(b)(3), and was transmitted to the Environmental Quality Council on August 7, 1976.

Sincerely,

Wayne A. Wetzel

WAYNE A. WETZEL
ENVIRONMENTAL COORDINATOR

WAW:bjt
Enclosure

DRAFT ENVIRONMENTAL IMPACT STATEMENT

PROPOSED REPAIRS
TO
PAINTED ROCKS DAM

Prepared by

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
WATER RESOURCES DIVISION

Submitted Pursuant to:

Montana Environmental Policy Act
Section 69-6504(b)(3)

August, 1976

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I. INTRODUCTION: DESCRIPTION OF PAINTED ROCKS DAM AND LAKE

Painted Rocks Lake on the West Fork Bitterroot River is a multipurpose project built in 1938 by the former Montana State Water Conservation Board with funds from the Public Works Administration. The State Water Conservation Board became the Water Resources Division of the Department of Natural Resources and Conservation (DNRC) in 1971. The 32,362 acre-foot reservoir, originally used for the agricultural benefit of the Bitterroot Valley, today also provides recreation and minimal flood control to many local residents. Only three contracts for this stored water are presently active.

Painted Rocks Dam, located in Ravalli County about 23 miles south of Darby, Montana, is shown in Figure 1. The drainage basin, mountainous and forested, ranges in elevation from 4,468 feet at the top of the dam to about 8,900 feet at the headwaters of the West Fork Bitterroot River. The drainage area above the dam encompasses 317 square miles.

When the inflow is greater than the outflow, the reservoir fills until it reaches its capacity (32,362 acre-feet). Above this level, water flows over the spillway. This occurs nearly every spring when the mountain snows begin to melt. Runoffs capable of filling the entire capacity of the reservoir five times in the course of three months (April, May, and June) are common.

The earth-fill dam, over 140 feet high and 800 feet long with a volume of 850,000 cubic yards, retains a three-mile-long reservoir. The concrete spillway drop at the right abutment of the dam has a capacity of 26,000 cubic feet per second (cfs). A concrete-lined rock outlet tunnel, in an almost circular shape with a diameter of approximately 10 feet, emerges from the dam at the base of the spillway (see Figures 2 and 3). There is a self-sealing rectangular slide gate used in the normal operation of the dam and another to be used in emergencies when the first gate is being repaired. These identical gates measure approximately five feet wide by eight feet high. Between the rectangular gate and the circular tunnel there is a *transition area*.*

This dam is operated by personnel from the Field Headquarters of DNRC in Hamilton, Montana. They control the gate that regulates the flow from the reservoir, and perform maintenance, repair work, and periodic inspections.

*Words in italics are defined in the Glossary, pages 58-59.

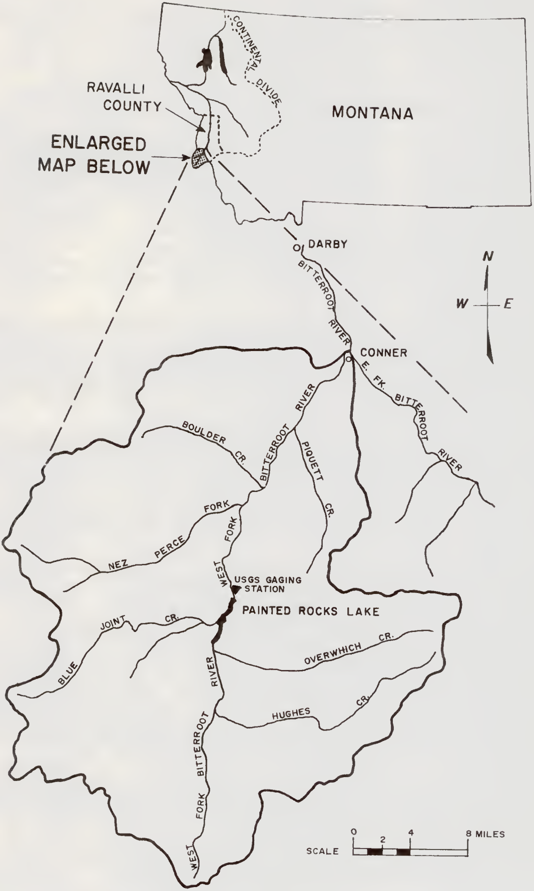

Figure I. LOCATION AND DRAINAGE BASIN MAP

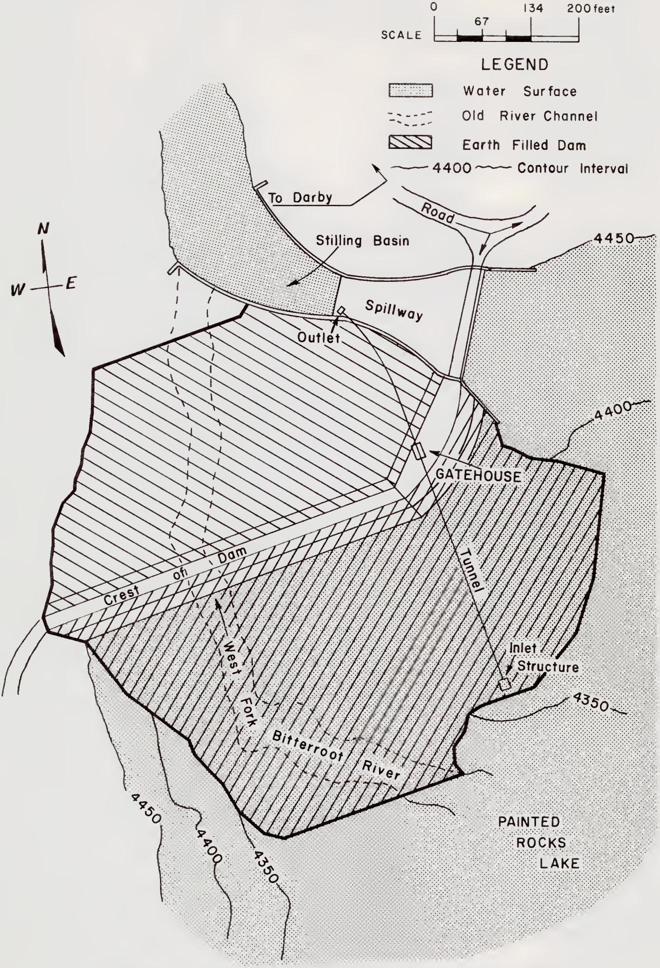

Figure 2. TOP VIEW OF PAINTED ROCKS DAM

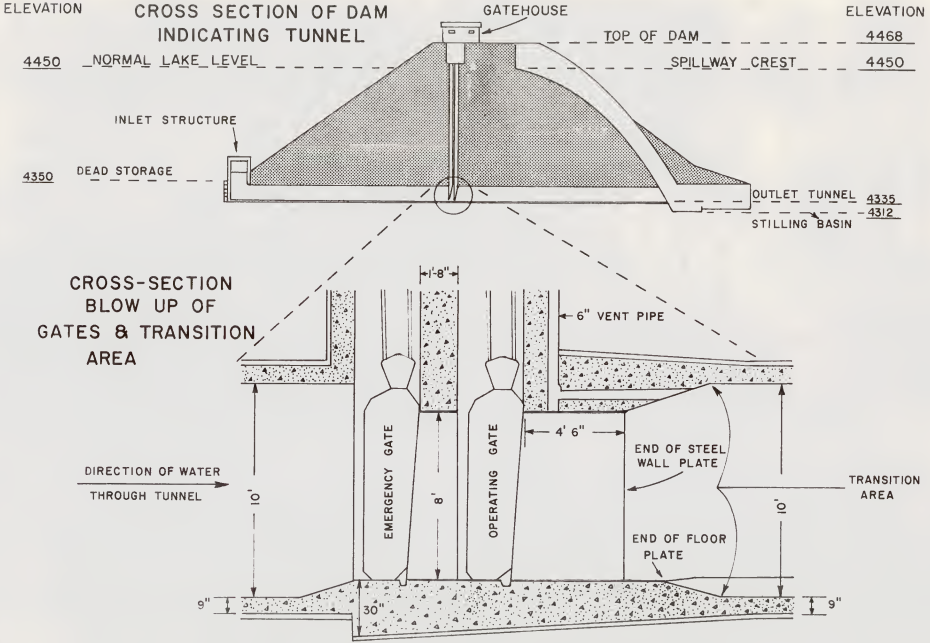

Figure 3. CROSS SECTION OF DAM AND GATE AREA

II. DESCRIPTION OF PROPOSED ACTION

During the high flows in the spring of 1975, Painted Rocks outlet tunnel sustained significant damage. In the transition area of the outlet tunnel, concrete, reinforcing bars, and a section (two feet by five feet by one-half inch thick) of steel plate were washed out, leaving in one location, only natural rock as the water-carrying surface (Figure 4). The concrete wall separating the operating and emergency gate towers was also damaged; cracked and deteriorating, the wall leaks when the operating gate is not in use and the emergency gate is used for regulation or stoppage of flows. This leakage results in the ineffective use of the emergency gate.

To restore the safe operation of the dam and prevent dam failure, it is proposed that the damages be repaired. Repairing the outlet tunnel will make the dam fully functional again; presently, the use of the tunnel is being limited to prevent further damage. However, the tunnel must be used to empty the reservoir for repairs. Repairing the wall between the gates will restore complete emergency control of the dam in the event that the operating gate becomes non-functional. Repairs to the intermediate wall will require the draining of the reservoir to allow dry access to the upstream face where the cracking originates (Figure 4).

HISTORY OF OPERATION AND MAJOR REPAIRS

Major repairs were made to the transition area of the outlet tunnel in 1954 and 1974, involving the placement of new concrete and steel. In 1971, the operating gate cable broke while in service, creating an emergency which necessitated 36 hours of continuous repair work to replace the control cable and restore the outlet control. In 1973, the old, worn bronze seals of the operating and emergency gates were replaced with stainless steel.

During the last six years, the operation of the dam has been changed. Increased emphasis on flood control has resulted in the maintenance of lower reservoir storage levels before the peak runoff occurs. Even so, large flow releases in early spring are still not sufficient to prevent the reservoir from filling up rapidly during the runoff. Because of the dam's small size only minimal effect on the downstream peak flow is provided by the reservoir. The downstream peak flow is delayed by several days, and its intensity is decreased by a small percentage. The primary

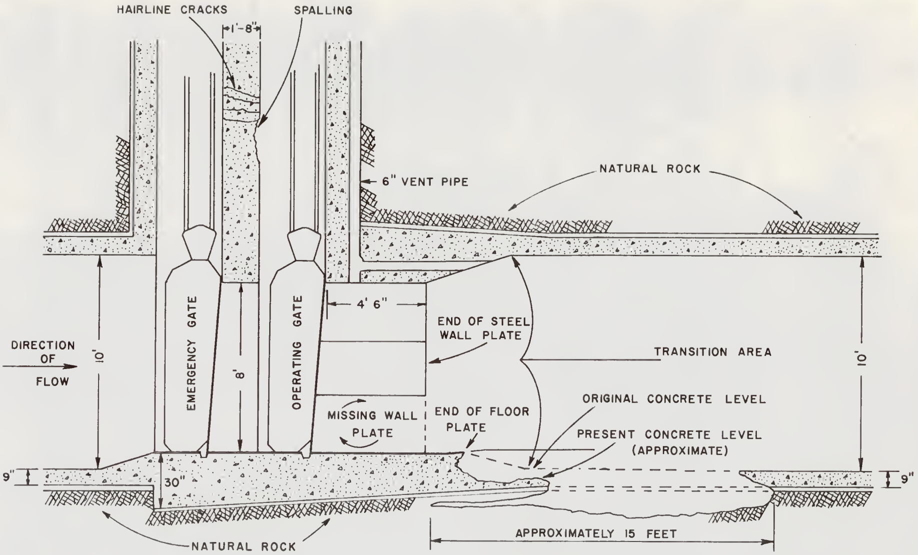

Figure 4. CROSS SECTION OF GATES AND TRANSITION AREA SHOWING DAMAGE

benefit that the reservoir offers is the increased downstream flow during the dry summer months.

PRESENT CONDITION

A recent annual dam safety inspection of the Painted Rocks Dam took plae on September 23, 1975, revealing several instances of deterioration.

The concrete wall which separates the emergency and operating gate towers is deteriorating (see Figure 4). Parts of this wall are cracked and *spalling*, so that, when water fills the emergency gate tower, it leaks through to the operating gate tower. If these cracks enlarge, repairs will be necessary or the potential use of the emergency gate will be lost. Repairing these cracks would call for the draining of the reservoir to eliminate water pressure upon the wall between the towers.

The spillway, which has been used nearly every year since the dam was built, remains in relatively good condition. There is some wear on the concrete surface of the nearly vertical face; however this wear and some transverse cracks do not appear to be serious.

The worst deterioration is in the transition area of the outlet tunnel of the dam, the location of repairs in 1954 and 1974. Deterioration in the transition area is a result of cavitation, a process that occurs when water encounters a decrease in pressure while moving rapidly from the confined area at the gates into the enlarged area of the transition zone. This decrease in pressure causes vapor bubbles to be formed. These bubbles are carried along with the water until a region of higher pressure is reached, where they suddenly collapse. The ensuing inrush of water produces regions of high pressure which extend into the pores of the adjacent metal or concrete and tear material from the solid surfaces resulting in pitting. Concrete on the tunnel floor and sidewalls has eroded substantially from this process and, in one location, is down to bedrock. A section of the steel plates has washed out from the sidewall of the transition area, and concrete erosion is taking place behind other plates.

On September 29, 1975, representatives from the Bureau of Reclamation joined with DNRC to make another inspection of the severely damaged outlet tunnel. Further investigation revealed undermined areas beneath the remaining concrete floor (Figure 4). By probing with a tape measure, many areas were found to have voids in excess of two feet. A maximum undermined distance of six feet was measured.

A representative of the Corps of Engineers, called in for further expert opinion, made another tunnel inspection on

November 12, 1975. At that time the damage appeared to be unchanged from the previous inspections. The report on this inspection (Appendix A) restated the severity of the problem. Recommendations were an immediate study of the problem and commencement of repair work as early as possible in 1976.

NATURE OF PROPOSED ACTION

DNRC, in an effort to restore the safe use of the outlet tunnel and reduce the likelihood of recurring damage, has contracted Harza Engineering Company to study this problem. Their plan is to investigate all the hydraulic features of the existing outlet system and design a new transition area. Of primary importance to the design is the shape of the transition and its ability to allow for aeration of the flow. To bring the necessary air into the tunnel at the transition, a vent, three and one-half feet in diameter, is now being planned to replace the inadequate six-inch vent which is presently in use. High-strength concrete, reinforcing steel, and steel plates will again be needed in the tunnel repairs. In order to repair the wall between the operating and emergency gate towers, the reservoir will have to be drained, allowing the work to be performed on the affected area while the tower walls are dry.

PROVISION FOR DOWNSTREAM FLOWS

To preserve the fishery resource in the West Fork, the Department of Fish and Game (DFG) has suggested a minimum discharge of 100 cfs during the repair period, based on a stream resource maintenance flow study conducted in 1975 on the West Fork Bitterroot River near the Rombo Campground three miles below the dam. The study data, summarized in Table 1, indicate the percentages of available aquatic habitat for several categories at various stream discharge rates. The Fish and Game study concluded that deep pools (two feet or more in depth) provide the majority of the fish habitat, and shallower pool areas with overhead cover provide much of the remainder. Twenty-five percent of the total habitat in the first category and forty-four percent in the second will be maintained by a flow of 100 cfs.

TABLE 1.--Percentage of total available aquatic habitat on the West Fork Bitterroot River from Painted Rocks Lake to the Nez Perce Fork, based on data from a 1975 streamflow study.

Discharge (cfs)	Stream Width Percentage	Pool Width Percentage	Pool Width .5 ft. depth plus overhead cover Percentage	Riffle Width 1.0 ft. depth Percentage	Pool Width 2.0 ft. depth Percentage
250	100	100	100	100	100
150	89	88	65	84	45
100	76	73	44	69	25
80	67	65	38	52	7
50	55	51	26	37	0
20	39	33	15	21	0

Source: Posewitz 1976.

Two methods are being studied that would provide flow to the river from the reservoir during the repairs:

1. During the outlet repairs in 1974, a steel pipe (12-inch diameter) was attached to the emergency gate and continued the length of the outlet tunnel. The discharge fluctuated from 15 to 35 cfs due to the changing level of the reservoir. This system of maintaining flow requires that the lake be drained twice, once for installation and once for removal of the valve from the emergency gate. The pipe, because of its location and its support apparatus, was an obstacle during the recent repairs. Since a much larger pipe would be needed to provide 100 cfs, an even greater obstacle would be created during the proposed repairs.

2. It would be possible to siphon and pump minimum flow over the spillway crest, if the water were kept away from the access to the outlet tunnel on the west side of the spillway. This system would require five to ten 16-inch, highlift pumps and about 1,000 feet of both steel and butyl pipe. The pumps must be capable of pumping the expected flow (75 to 150 cfs) to assure that, during the repairs, the reservoir would not fill, forcing water over the spillway and blocking access to repairs.

DURATION, TIMING, AND FUNDING OF THE PROPOSED REPAIRS

The repairs within the outlet tunnel of the dam will require several months of work. Exploratory work, consisting of test drilling through the walls of the tunnel to locate voids, is needed before any major concrete placement can take place. The amount of time required for actual repairs after the drilling will depend on the design of work needed for the transition and gate area.

The flow chart (Figure 5) indicates the approximate time schedule for the repairs. Construction is to begin October 1976, and be completed by the spring runoff of 1977, providing for at least five months of work. During this period, an attempt to provide minimal downstream flows may be made according to one of the methods stated in the previous section of this report.

To restore the safety of the outlet structure, application for financial assistance was made to the Soil Conservation Service (SCS) under the Emergency Assistance Program, authorized by Section 216 of the Flood Control Act of May 17, 1950. Funds have been allocated for design, construction and inspection of the proposed repairs but are contingent upon SCS review and approval. The funds constitute a major portion of the repair budget.

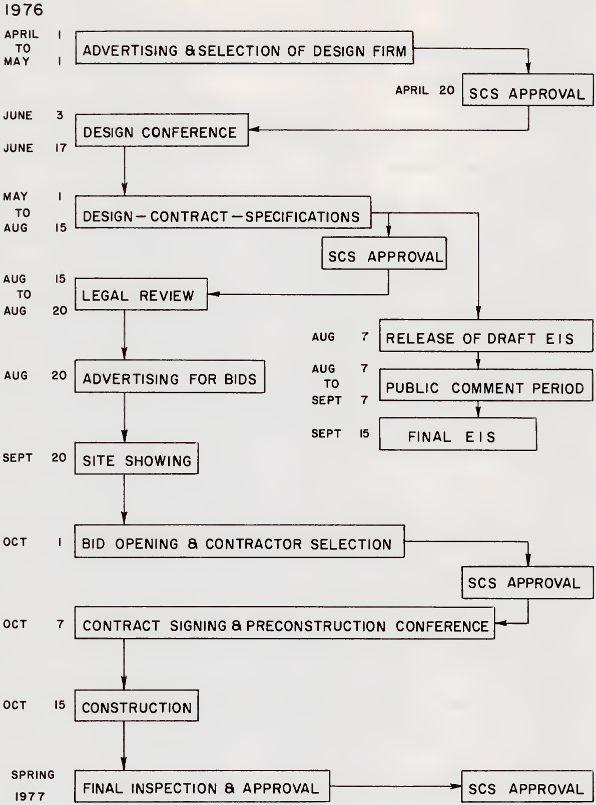

Figure 5. SCHEDULE FOR PAINTED ROCKS REPAIRS

III. ENVIRONMENTAL INVENTORY

NATURAL ENVIRONMENT

Climate

Due to the mountain-valley terrain of southwestern Montana, the climate within the study area varies greatly (U.S. Department of Commerce 1974). The West Fork Valley is surrounded and sheltered by the Bitterroot Mountains. The higher elevations (8,000 feet and above) receive an average of over 30 inches of precipitation a year; while at Darby, Montana (elevation 3,880), near the confluence of the East and West Forks Bitterroot River, the annual average is 16 inches.

The average annual snowfall along the West Fork river bottom is 100 inches, increasing to an average of 600 inches along the Idaho-Montana border near Trapper Peak (U.S. Department of Agriculture 1975). Flow in the major streams peaks during either May or June when temperatures increase and monthly precipitation is highest.

The average yearly temperature at Darby is 45°, with a January average of 26° and a July average of 65°. The average freeze-free season at Darby is 99 days; areas along the West Fork Valley probably have an even shorter season. Snow falls on the high peaks as early as late August. The winters are long and cold; however, extreme cold (-10° or colder) along the valley bottom seldom persists longer than 10 days at a time.

Water Resources

Hydrology. The West Fork Bitterroot River rises in the Bitterroot Mountains of southwestern Montana and flows in a northerly direction to its confluence with the East Fork near Conner, Montana. The West Fork watershed (Figure 1, page 2) has a drainage area of 558 square miles, 317 of which lie above Painted Rocks Dam, so that the dam and reservoir are approximately in the center of the watershed.

Elevations in the West Fork watershed range from 8,000 to 9,000 feet along the upper watershed boundary to 4,000 feet at the mouth. A profile of the West Fork is presented in Figure 6. From this the average slope below the dam was computed to be 25.2 feet/mile. The valley of the West Fork is steep-sided and narrow,

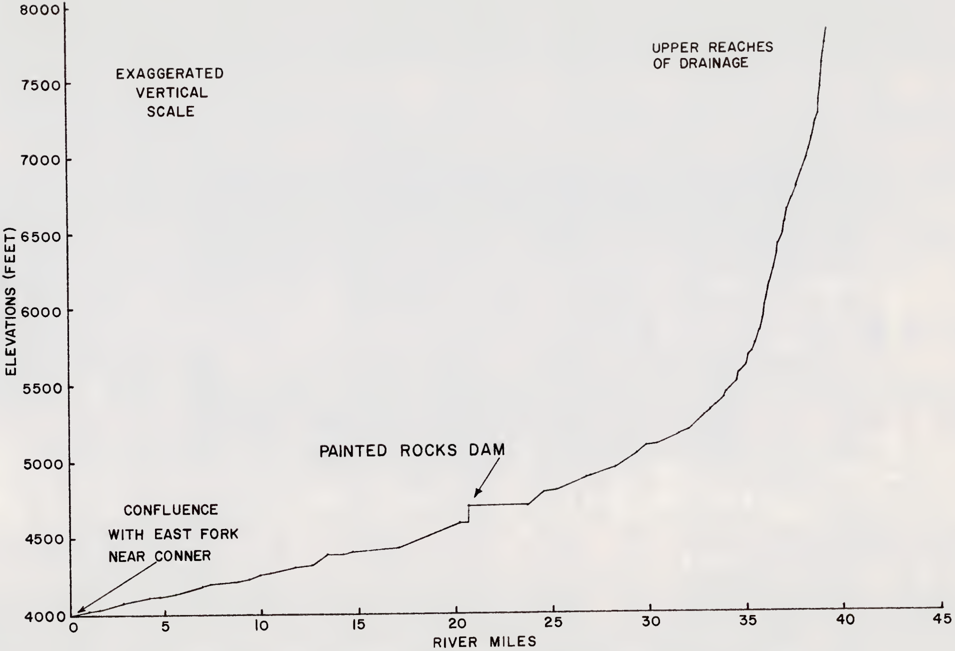

Figure 6. STREAM PROFILE — WEST FORK BITTERROOT RIVER

and the river is fairly straight.

Streamflow in the West Fork averages 211,600 acre-feet per year (292 cfs). Of this, 71% occurs during April, May, and June as runoff from snowmelt. The maximum flow recorded on the West Fork was 4,060 cfs on May 9, 1947. A minimum flow of 0.2 cfs was observed on November 25, 1952. Low flows such as this have resulted from time to time due to the closing of the dam for inspection or repairs and would not naturally occur. All flow data presented here were taken from the United States Geological Survey (USGS) records obtained from a stream-gaging station 0.6 mile downstream from Painted Rocks Dam. This station has been in continuous operation since April, 1941, providing 34 years of information. Appendix B contains additional yearly maximum and minimum flows.

Ground Water. The ground-water system downstream from the dam is composed of both a bedrock aquifer and an alluvial aquifer.

The bedrock aquifer consists of water-saturated fractured rock which can produce enough water to supply wells. Recharge to this aquifer is provided by precipitation infiltrating the ground surface and entering the bedrock fractures. This aquifer is largely unused at this time.

The alluvial aquifer is composed of unconsolidated sands, gravels, and clays closely tied hydrologically to the West Fork. When stream flows rise, water levels in the stream are higher than the prevailing ground-water table, causing water to flow downgradient from the stream to the aquifer. This results in water being stored in the ground and a rise in ground-water levels. When stream flows drop, the reverse is true, and water flows from the aquifer to the stream. Recharge to the alluvial aquifer comes from two sources. Some water probably moves by gravity from the bedrock aquifer to the alluvium, but the primary source of recharge is the West Fork. This aquifer has been used to provide water for domestic use.

Water Quality. The water quality of the West Fork Bitterroot River is generally very good according to Montana water quality standards. The U.S. Forest Service (USFS) (Bitterroot National Forest) has established nine monitoring stations along the river and its tributary streams; data collected at these stations indicate that values are well within safe drinking water standards (U.S. Department of Agriculture 1975).

Water flowing from the main Bitterroot Mountains is unusually low in *hardness*, *total dissolved solids*, and *alkalinity*, a result of the rapid runoff through the resistant *igneous* and *metamorphic* rocks. Most water in the drainage may be classified as "soft" because the hardness or calcium carbonate ($CaCo_3$) level is less than 60 milligrams per liter (mg/l). The total dissolved solids

(TDS) are normally measured at less than 60 mg/l, well within U.S. Public Health Service recommendation that the maximum TDS concentration for human drinking water should not be greater than 500 mg/l (U.S. Department of Health, Education, and Welfare 1962). Water temperatures usually range between 32° and 59° with a maximum of 65°. *Dissolved oxygen* (DO) levels are usually near saturation. Although the waters of the West Fork are of good quality for drinking, alkalinity, hardness, and *specific conductance* are below the levels associated with optimum growth and diversity of beneficial aquatic organisms.

Increased turbidity in the West Fork below the dam is known to occur when the reservoir is drawn down to the dead storage level. Suspended sediment in this turbid water may carry harmful bacteria or pesticides.

Vegetation

Most of the West Fork drainage is forested. The major tree species in the forest are ponderosa pine, Douglas fir, Engelmann spruce, lodgepole pine, and subalpine fir. Whitebark pine and alpine larch are found sparsely at higher elevations.

The common grasses, shrubs, and grasslike plants include: pinegrass, Idaho fescue, bluebunch wheatgrass, beargrass, snowberry, bluegrass, elk sedge, grouse whortleberry, mallow ninebark, menziesia, willow, alder, ceanothus, huckleberry, mountain mahogany, and balsam root.

Wildlife and Fisheries

Wildlife. The availability of water is generally not limiting to populations of terrestrial animals, including elk, mule deer, moose, and black bear, which inhabit the West Fork drainage, as precipitation is relatively high and streams are abundant. Several species, however, are dependent upon the extent and availability of aquatic environments in the drainage; these include amphibians, reptiles, and particular birds and mammals.

Painted Rocks Lake is used as a stopping-over area for waterfowl during spring and autumn migrations, but few remain in summer to breed. Osprey, which are dependent on fish for food, may nest along the reservoir shores since they are known to nest on Lake Como. Great blue herons feed along the West Fork, but, while nesting colonies are known along the mainstem of the Bitterroot River, none are known in the area. Other birds which are closely linked to aquatic environments of the area are the dipper, spotted sandpiper, killdeer, and common snipe.

Mammals associated with aquatic environments of the West Fork area are the mink, beaver, and muskrat. River otters are found

downstream in the Bitterroot mainstem but are not likely to be in the West Fork. The northern water shrew and possibly the water vole occur at higher elevations in the West Fork drainage.

Fishery. The West Fork Bitterroot River below Painted Rocks Lake provides an important local sport fishery and is classified by the Stream Classification Committee (1965) as a Class 3 fishery (of importance to a large district). Six species of game fish (mountain whitefish, Westslope cutthroat trout, rainbow trout, brown trout, brook trout, and Dolly Varden) occur in the river, as well as several nongame species, including longnose sucker, sculpin, and longnose dace. Of the game fish species, only Westslope cutthroat trout, Dolly Varden, and mountain whitefish are native to the drainage.

Following an extensive drawdown of the reservoir and dewatering of the river in 1974, supplemental stocking of catchable trout has been necessary to maintain a sport fishery in Painted Rocks Lake and the West Fork Bitterroot River. At present, the success of the stocking program and recovery of the sport fishery is difficult to determine because data pertaining to fish population levels since the 1974 dewatering are not available. However, it is likely that the same game species occur in the lake, with the stocked rainbow trout predominating. Fish population estimates for a 2,000-foot section of the West Fork below Painted Rocks Lake in 1973 are presented in Table 2.

TABLE 2.--Fish population statistics for a 2,000-foot section of the West Fork Bitterroot River below Painted Rocks Lake, October 4 and 5, 1973.

Species	Group (inches)	Estimated Number	80% Confidence Interval
Hatchery rainbow trout	6.7-12.0	88	± 14
Rainbow trout	3.5- 5.9	194	± 36
	6.0- 8.9	45	± 13
Cutthroat trout	2.3-11.5	71	± 11
Mountain whitefish	2.1- 5.9	927	± 328
	6.0- 7.9	384	± 146
	8.0-11.9	2267	± 294
	12.0-16.3	189	± 68
	Total	3767	± 469
Dolly Varden	6.3-12.7	No estimate	
Brook trout	3.2-10.0	No estimate	
Suckers	4.2- 8.9	497	± 186
	9.0-20.2	621	± 199

Source: Posewitz 1976.

CULTURAL ENVIRONMENT

Land Use

Ownership. Along the West Fork river bottom the majority of land is privately owned. Maps in Appendix C show the location of private land and the surrounding USFS boundaries.

Woodland and Water. With the exception of recreation, human activity in the West Fork drainage is not heavy. The main use of most of the area is as forested watershed (under management of the Bitterroot National Forest), providing wildlife and fish habitat.

Agriculture. The short stretch of river bottom between the dam and the confluence of the East Fork (approximately 20 river miles) is mostly covered by timber and brush; only a small amount is irrigated to produce hay, which is generally used locally rather than sold as a cash crop. Cattle and horses graze on the natural grasses and cultivated hay. Some landowners in the West Fork Valley have limited-production vegetable gardens.

Recreation. Fishing for trout and whitefish is the major recreational activity in the West Fork Valley. Although the fishing season extends from mid-May to mid-November, mountain whitefish may be caught year-round. Trout fishing during the winter months is restricted to Painted Rocks Lake.

Summer recreation includes boating, swimming, water skiing, and floating. Camping, especially at USFS and DFG campsites, hiking, and backpacking are also popular (U.S. Department of Agriculture 1975).

In the fall, sightseers as well as hunters use the roads in the drainage. Although winter snow limits traffic, cross-country skiers, snowshoers, and snowmobilers use the area.

Water Rights

Existing Surface Water Appropriations and Contracts. Filed water rights dealing with the West Fork Bitterroot River are filed in the Ravalli County Courthouse in Hamilton, Montana. Although the West Fork Bitterroot River was adjudicated in 1912, water rights in its tributaries have not been subjected to court adjudication.

No municipalities are located along the West Fork. Darby, the closest town, is located on the west side of the Bitterroot River about seven miles downstream from the confluence of the East and West Forks. Two shallow wells provide most of Darby's residents with their water needs.

There is no industrial depletion of West Fork waters.

Irrigation of river-bottom lands by surface water is the major use of water in the West Fork Valley. During the 1974 repairs and some extremely dry summers, water purchase contracts have been written which called for supplemental water to be released from the reservoir in late summer months when the river naturally runs lowest.

Currently, there are two small, active agricultural water purchase contracts for 1976 with DNRC (James Ruark, 20 acre-feet; Albert Larghi, 100 acre-feet). Another contract with the Montana DFG and the Ravalli County Fish & Wildlife Association for 5,000 acre-feet annually has been on record since 1958.

The purpose of this contract is to supplement late summer flows in the Bitterroot River for the beneficial use of its aquatic life. During periods of low flow, however, farmers with agricultural use rights divert this excess flow from the dam, for irrigation. It is, therefore, difficult in dry years to maintain a prescribed minimum flow since claims for irrigation water are greater than the actual flow (Senger 1975).

Ground-water Appropriations. Wells provide the West Fork Valley inhabitants with the majority of their domestic water supply. The Water Rights Bureau of DNRC has on record eleven filed ground-water rights along the West Fork between Painted Rocks Dam and the inflow of the Nez Perce Fork. These wells, listed in Appendix C, range in yield from 0.5 gallon per minute (gpm) to 50 gpm and in depth from eight feet to 182 feet. Additional appropriations probably exist that have not been filed with DNRC, but the amounts and use of the water is not known. However, they are probably similar to those appropriations listed in Appendix C.

IV. ALTERNATIVES

ALTERNATIVE TIMES OF ACTION

DNRC has evaluated several alternative times for commencing the repair work at Painted Rocks Dam. The spring and summer seasons were eliminated because of exceptionally high, unpredictable inflows and the necessity of fulfilling downstream irrigation requirements. Other alternatives, their advantages, and disadvantages are presented below.

Alternative 1. Make the proposed repairs during fall and winter.

Advantages

1. The low inflow, stable at generally less than 100 cfs from September until March, would reduce the risk of filling the reservoir. A full reservoir would necessitate using the spillway, which would shut down tunnel repair operations.

2. Beginning the repairs during the fall of 1976, which is the first reasonable opportunity, would stop the damage at its current level, reducing the cost of repairs and shortening the time necessary to make them.

3. By late fall, irrigation of valley farmland has stopped for the year, greatly reducing the possibility of negative impact on agricultural production as a result of reduced flow.

Disadvantages

1. Tributary inflow to the West Fork below the dam is low during the fall and winter, and small streams may freeze. Shutting off the flow through the dam, completely or partially, would most significantly affect the river below the dam when natural flows are at their yearly low.

2. Mountain whitefish, brown trout, brook trout, and Dolly Varden, which spawn in the fall, would suffer from the reduction in flow and probably lose the reproduction of that year.

3. Working conditions would be difficult in cold weather, resulting in more time being required for repairs. Roads to the job site may become blocked by heavy snow accumulation.

4. The West Fork itself may freeze. A total freeze would eliminate aquatic invertebrates and fish. When the water is returned to the river after repairs, any ice remaining in the river would break up, possibly forming ice jams and causing channel scouring and flooding.

Alternative 2. Postpone repairs.

Advantages

1. There would be no immediate impact on the natural environment.

2. Future developments, such as the improvement of methods or materials, could reduce the time and/or cost required for the repairs.

Disadvantages

1. Postponing the repairs would probably result in an increase in the amount of damage to the outlet tunnel. This could cause longer repair time and, along with inflation, higher costs when the repairs are finally performed.

2. The dam could fail before repairs are done, causing environmental damages and, possibly, loss of life and property.

3. Control over the flow through the dam could be lost before repairs are done, eliminating the downstream benefits derived from that control and creating safety and engineering difficulties when repairs are begun.

ALTERNATIVE TYPES OF ACTION

Since the safety of the dam will decrease as time progresses, the alternatives of constructing a new dam, breaching the existing dam, or building an additional outlet tunnel were not seriously considered; any of these would require a number of years for completion. Sealing off the gates permanently and allowing future inflow to use the spillway was also not considered feasible. Drawdown of the reservoir to stop the flows over the spillway would be necessary for any repairs--a difficult task without a usable outlet tunnel.

Other alternatives discussed below indicate the advantages and disadvantages of providing downstream flow during the repair period.

Alternative 1. Drain the reservoir in late summer and early fall of 1976; install a pipeline though the outlet tunnel to provide a minimum downstream flow (Figure 7).

Advantages

1. With the exception of installation and removal time, this pipeline would supply uninterrupted flow to the West Fork. Flows through the pipe would increase as the head (pressure) builds up while the reservoir fills. A range of flows between 15 to 35 cfs could be expected. This minimum flow would help to assure a limited but continued aquatic environment.

2. Further deterioration of the outlet tunnel would be prevented.

3. It would not be necessary to use the spillway to maintain downstream flow, thus eliminating the costs of either the pumping system or control structure (both are discussed later in this alternative section). This is important since uncontrolled flow over the spillway would halt tunnel repairs, blocking access to the working area.

4. Drawing the reservoir down before the repairs begin would allow the repair of the wall between the emergency and operating gate towers.

Disadvantages

1. Use of this pipeline requires that the reservoir be drained twice, once for pipeline installation and again for removal.

2. Installation and removal of the pipeline would each take about one week. During this time, usually for eight hours each working day, the valve on the uncompleted pipeline would be closed shutting off flow in the river. This condition would continue until the entire pipeline from the emergency gate to the spillway face is completed.

3. The pipeline and its necessary supports are large enough to hinder the workmen performing the repairs. These obstructions would increase the time needed to complete the repairs.

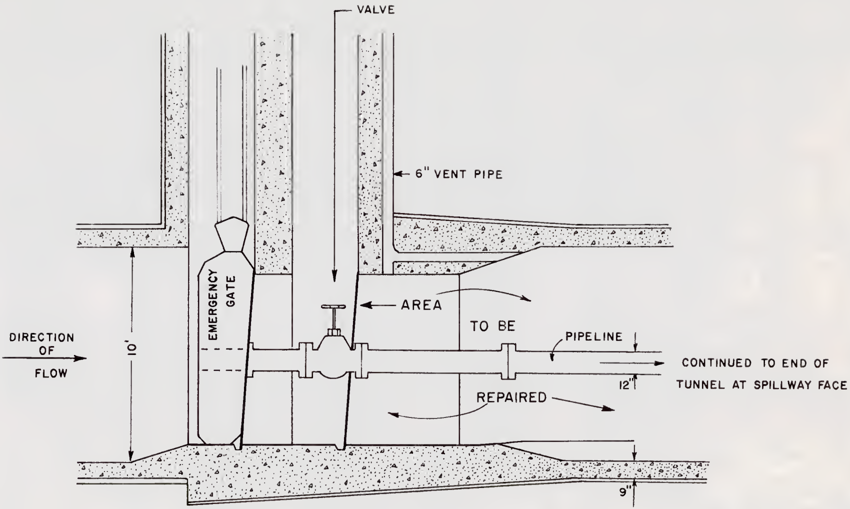

Figure 7. CROSS SECTION OF GATE
SHOWING PIPELINE USED FOR PROVIDING DOWNSTREAM FLOW

4. A risk is involved. Failure of this temporary pipeline during installation, repairs to the dam, or removal would create an extreme safety hazard.

5. The 12-inch pipeline, used during the 1974 repairs, produced a flow ranging between 15 to 35 cfs. This would again be the expected range of flows as the same pipeline would be used. This flow is far less than DFG's recommendation.

Alternative 2. Drain the reservoir in late summer and early fall of 1976; pump water over the spillway crest to provide a minimum downstream flow.

Advantages

1. A continuous minimum downstream flow would be provided. The actual amount would depend upon the pumping equipment selected and the height the water must be pumped.

2. Further deterioration of the outlet tunnel would be prevented.

3. Drawing the reservoir down before the repairs begin would allow the repair of the wall between the emergency and operating gate towers.

4. Without the pipeline and its accompanying support system in the outlet tunnel, working areas would be unobstructed, resulting in shorter repair time.

Disadvantages

1. The costs of acquiring and operating the pumping systems could be higher than the cost of the tunnel repairs. This amount is dependent upon the type of system selected and the length of time it will be in service.

2. Because the reservoir would be drained at the start of the repairs, an initial lift of approximately 120 feet would be necessary. Over 1,000 feet of pipeline would be required to move water over the spillway crest.

Alternative 3. Drain the reservoir in late summer and early fall of 1976; after repairing the intermediate wall, refill the reservoir during the spring and summer of 1977 to within a few feet of the principal spillway; pump the natural inflow over one side of the spillway while repairs to the transition area are made in the fall and winter of 1977.

Advantages

1. During the refilling of the reservoir, minimal releases through the outlet tunnel to the river could be allowed.

2. Because of the low head on the pumps, larger volumes of water can be pumped than could be while the reservoir is drained. However, actual flow of water provided to the river would depend upon the pumping equipment and the height the water must be pumped. These pumps would provide continued minimal flow to the river.

3. The cost of pumping large amounts of water decreases when the height the water must be pumped is reduced. Therefore, the cost of pumping water in this alternative would be less than in alternative 2.

4. Without the pipeline and its accompanying support system in the outlet tunnel, working areas would be unobstructed, resulting in shorter repair time.

Disadvantages

1. The amount of time needed to fill the reservoir after it is drained is dependent on the inflow. Since the river historically has low inflow during the winter, it is likely that the reservoir would not fill until the spring. Mountain snow runoff in the spring would become a problem since it would be necessary to use the entire spillway to handle that increased flow. This would result in the postponement of the transition area repairs until the fall of 1977, jeopardizing the safety of the dam for yet another year.

2. The costs of acquiring and operating the pumping systems could be higher than the cost of tunnel repairs.

3. Pumping capacity would have to adequate to handle all inflow; otherwise the repair operation would have to be shut down when the inflowing water crested the spillway.

4. During the daily eight-hour work period while the intermediate wall is being repaired, no downstream flow would be provided. During the transition area repairs in the fall and winter of 1977, flow would be dependent on the pumping system.

Alternative 4. Drain the reservoir in late summer and early fall of 1976; after repairing the intermediate wall, refill the reservoir during the spring and summer of 1977. Natural flows would be allowed to pass over the spillway and away from the tunnel access point during the transition area repairs in the fall and winter of 1977.

Advantages

1. During the refilling of the reservoir, minimal releases through the outlet tunnel to the river could be allowed. After refilling, all expected inflow to the reservoir may be passed over one side of the spillway away from the tunnel access, thus sustaining the aquatic environment.

2. Because pumps or pipelines would not be used to maintain the downstream flow, their cost would be avoided.

3. Without the pipeline and its accompanying support system in the outlet tunnel, working areas would be unobstructed, resulting in shorter repair time.

Disadvantages

1. The amount of time needed to fill the reservoir after it is drained is dependent on the inflow. Since the river historically has low inflow during the winter, it is likely that the reservoir would not fill until the spring. Mountain snow runoff in the spring would become a problem since it would be necessary to use the entire spillway to handle that increased flow. This would result in the postponement of the transition area repairs until the fall of 1977, jeopardizing the safety of the dam for yet another year.

2. Controlling the flows to one side of the spillway would require a structure to be built along the crest and face of the spillway. This controlling structure built with sandbags must be capable of handling all inflow while allowing discharge to only one-third of the present spillway width. A failure of this controlling structure would shut down repair operations and possibly trap workers in the outlet tunnel. Rescue of trpped workers would be expensive and dangerous.

3. The cost of the control structure and its installation would have to be added to the total cost of repairs.

4. During the daily eight-hour work period while the intermediate wall is being repaired, no downstream flow would be provided. During the transition area repairs in the fall and winter of 1977, flow would be dependent on natural inflows to the reservoir.

Alternative 5. Drain the reservoir; close the gates while repairs are being made, and provide no downstream flow.

Advantages

1. Because there would be no risk of pipeline failure or of workmen being trapped in the tunnel when the principal spillway is called into use, working conditions would be much safer than if downstream flow were provided.

2. The reservoir, which would fill while the gates are sealed and repairs are being made, would not have to be drained a second time, as it would if a pipeline through the tunnel were installed to provide downstream flow.

3. The time to construct any of the systems which would provide downstream flow would be saved. The repairs themselves would also take less time than under alternative 1 because there would be no pipeline and no pipeline support system obstructing the workmen's efforts.

4. The cost of providing downstream flow would be saved. These costs could be as much as, if not more than, those of the actual repairs themselves.

Disadvantages

1. Some aquatic life would be lost, but the amount would depend on the flow conditions in the river below the dam after the gates are closed. Tributary inflow would probably keep some fish and other aquatic organisms alive in the lower stretches of the river. No aquatic life would survive if the temperatures drop enough to freeze reduced flow.

2. Greater losses in the river's *food chain* would necessitate a longer regeneration period.

Alternative 6. Do nothing.

Advantages

1. The time, cost, and material for repairs would be saved.

2. There would be no immediate impact on the fisheries.

Disadvantages

1. Control of the dam would eventually be lost.

2. The safety of life and property below the dam would be in jeopardy, a condition which would increase with time.

V. ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

The final decision as to what action should be undertaken in response to the damage at Painted Rocks Dam will be based in part on the public's and other agencies' response to the information in this draft impact statement. For that reason no specific course of action is recommended in this draft impact statement; rather, a series of possible alternatives is given in Section IV. In the discussion which follows, possible impacts of those alternatives are treated. Because the DNRC is convinced that the repairs are necessary, it is assumed for the sake of this discussion that:

1. the repairs will be performed,
2. they will be done in fall and winter (the reasons that spring and summer are undesirable alternative seasons for repair are discussed in Section IV), and
3. the reservoir will be drawn down during repairs, since that is necessary for repair of the intermediate wall and is included in all repair alternatives.

The following impact matrix (Tables 3 and 4) provides a summary of impacts considered in evaluating the effects of the proposed action. Those portions of the natural and human environment significantly altered are discussed after the matrix summary.

TABLE 3.--Summary of potential impacts on the natural environment

			Major	Moderate	Minor	None	Unknown	Immediate	Cumulative	Discussed on page
1.	a.	terrestial life and habitats				X				32-36
	b.	aquatic life and habitats	X					X		
2.	a.	surface water quality, quantity, and distribution	X					X		31
	b.	ground water					X			36
3.		soil quality, stability, and moisture				X				
4.		geology				X				
5.		vegetation cover, quantity and quality				X				
6.		aesthetics			X			X		37
7.		air quality				X				
8.		unique, endangered, fragile, or limited environmental resources				X				
9.		historical and archaeological sites				X				
10.		demands on environmental resources of land, water, air, and energy				X				

TABLE 4.--Summary of potential impacts on the cultural environment

			Major	Moderate	Minor	None	Unknown	Immediate	Cumulative	Discussed on page
1.		social structures and mores				X				
2.		cultural uniqueness and diversity				X				
3.	a.	access to and quality of recreational activies		X				X		36
	b.	wilderness activities				X				
4.		local and state tax base and tax revenue				X				
5.		agricultural, commercial, or industrial production			X			X		36
6.		human health	X					X		37
7.		quantity and distribution of employment				X				
8.		distribution and density of population and housing				X				
9.		demands for local government services (school, water, health, police, etc.)				X				
10.		locally adopted environmental plans and goals					X			36
11.		transportation networks and traffic flows				X				
12.		demands for energy			X			X		40
13.		quantity and distribution of community and personal income				X				

IMPACT ON NATURAL ENVIRONMENT

Surface Water

Water Quantity. Drawdown of the reservoir will reduce the pool from 32,362 acre-feet to a *dead storage* level of 656 acre-feet. During the repair period the reservoir may refill, depending on which repair alternative is chosen, but downstream flow will probably be reduced. If alternative 1 is chosen, complete closures for up to eight hours per day will take place during the five-to-seven day periods allocated to install and remove the bypass pipe and valve. Under alternative 5 no flow will be provided during repairs.

For any alternative chosen, some additional flow will be derived from seepage through the dam structure and underlying geologic formations, ground-water seepage, and tributary inflows. Data are not available to assess how much supplemental flow will be added to the bypass flow in the most critically affected reach immediately below the dam. Above average precipitation in early 1976 may have produced higher than normal ground-water return to the main channel and tributaries.

Water Quality. A temporary increase in turbidity will be an unavoidable result of the proposed repairs. As the reservoir is drawn down (alternative 1 would require two drawdowns), the West Fork will reestablish its channel in the silty sediments exposed, resulting in increased turbidity both in the reservoir and downstream from the dam. Turbidity increases of more than five Jackson Turbidity Units (JTU--a measure of dispersion of light by suspended particles in the water) are common during reservoir drawdowns. No turbidity data have been collected during previous repair periods, but the five JTU allowable turbidity increase (barely perceptible visually) applicable to the West Fork will almost certainly be exceeded, based on past observations of clouding by suspended sediments (Water Quality Standards 1974).

In addition, water quality may be adversely affected by a greater-than-normal temperature range fluctuation. Because repairs will be done over the winter months, the entire reduced flow below the dam may freeze.

Normal fall disruption of summer *thermal stratification* in the reservoir is expected. The reservoir will fill during the repair operation, and abnormal temperature change effects there are not anticipated.

Impacts to Vegetation

No adverse impacts to vegetation are expected.

Impacts to Wildlife

The proposed drawdown is scheduled to occur during a season when reptiles and amphibians are inactive and breeding birds are absent from the area; hence impacts to populations of these species due to alteration of aquatic *habitat* or reduction of food supply are expected to be insignificant. The lake is not an important stopping-over area for waterfowl in the fall. The magnitude of the effects of short-term drawdown on the habitat or food supply of big game, non-game, aquatic, or semiaquatic mammals is also not great enough to significantly affect long-term carrying capacity.

Impacts to Fish and Aquatic Invertebrates

Impacts to the area's fishery could result from two aspects of the proposed alternatives: 1) a reduction of the level of Painted Rocks Lake to dead storage stage, and 2) reduced flows in the West Fork below the Painted Rocks Dam for the duration of the repair project.

Impacts Resulting from the Drawdown of Painted Rocks Lake. Negative effects on aquatic life could result from displacement, stranding and entrapment, increased turbidity, altered habitat productivity, and ice formation.

1. Fish displacement. Displacement, or population redistribution resulting from disturbance or other environmental change, is a special case of habitat alteration which causes fish to avoid an otherwise suitable area. Fish populations in the reservoir can be expected to display an increased displacement trend as reservoir conditions deteriorate and fish populations concentrate in a smaller area as a result of lowering water levels. The greatest displacement would occur in a downstream direction; fish would leave the reservoir through the outlet tunnel. Some mortality may occur as a result. Some fish may displace upstream into the reservoir tributaries, although the number would probably be insignificant.

2. Fish stranding and entrapment. As the water level of the reservoir lowers, fish may become trapped in areas with depressions or side basins. Once trapped, mortality rates are expected to increase as a result of increased predation, lowered oxygen levels, starvation, or ice formation. Whether this would involve a significant number of sport fish is not known since there is no information on present fish population levels in the reservoir.

3. Increased turbidity. Drawdown of the reservoir to the level proposed under several of the alternatives would probably cause increased turbidity and sedimentation,

as it did in 1974. Tributary streams above the dam would flow through sediment deposits as the reservoir water level is lowered, resuspending the sediment in the reservoir. Turbidity levels would increase further as less water becomes available for dilution of the introduced sediment. Excessive turbidity affects fish directly by reducing visibility (limiting the ability of the fish to locate food sources), clogging the gills with particulate matter, and abrading external tissues by the action of suspended solids (Phillips 1970, Saunders and Smith 1965, Chapman 1962). Increased turbidity may directly affect the fish populations of the reservoir by encouraging displacement as well as contributing to increased mortality rates.

4. Habitat productivity. Although the reservoir is potentially productive, past fluctuations in the water level have discouraged the establishment of habitat capable of maintaining a self-sustaining fishery. Because of this, the impact of reservoir drawdown on existing habitat productivity is not expected to be significant.

5. Ice formation. If an extensive ice cover forms over portions of the lowered reservoir containing fish, a depletion of the oxygen supply could result, contributing to the fish mortality rate.

Impacts Resulting from Reduced Flow in the West Fork. All of the action alternatives considered would result in reduced flow in the West Fork downstream from the dam. Alternative 1 would provide some flow through the outlet tunnel via a pipeline; but downstream flow through the existing pipeline would be only 15 to 35 cfs, much less than the 100 cfs DFG has suggested as the critical minimum flow necessary to maintain the sport fishery (Table 1, page 9). Under alternative 5, no flow would be provided from the reservoir, so that the West Fork flow sources would be reduced to seepage and tributary inflow. Thus, serious impacts to the aquatic resources of the West Fork may occur during the proposed repairs. These impacts could result from displacement, stranding and entrapment, increased turbidity, ice formation, or zero discharge.

1. Fish displacement. Lowering water levels due to the initial reduction in reservoir discharge can be expected to cause downstream displacement of fish in the West Fork. It is expected that the fish would continue downstream movement until the larger tributaries provide areas of greater flow and/or more stable habitat. Although most fish may survive the initial displacement, other factors would contribute to an increase in the mortality rate. For example, it can be assumed that much of the available fish habitat downstream is occupied by resident fish populations. Competition for habitat and food supply in these

areas would increase with the addition of fish displaced from upstream areas. A downward adjustment in the combined fish populations can be expected in response to the area's carrying capacity.

2. Stranding and entrapment. A certain portion of the fish population can be expected to be trapped in side pool areas or stranded in shallow areas as the flow in the West Fork is reduced. This potential occurrence is expected to be greatest along portions of the stream with gently sloping channels. Here, initial reduction in flow may dewater large areas rapidly, trapping fish in side channels or pools. Eventual dewatering of these areas, increased predation, oxygen depletion, starvation, or ice formation may contribute to high mortality rates. Along sections of the river with larger pools, tributary flows and seepage may increase the chances for fish survival.

    During the likely fall-winter repair period, seasonal spawning concentrations of mountain whitefish are present in the West Fork (Table 2, page 17) and may be especially vulnerable to stranding or entrapment, which could prevent successful spawning. Dolly Varden, brook trout, and brown trout, late season spawners which are present in much smaller numbers, may be similarly affected.

    Aquatic insects, the major source of food for the area's fish species, are also susceptible to stranding. As with fish, the potential for stranding is greatest along sections with gently sloping shorelines. Here, the low water velocities at or near the shore reduce the chance for escape by drifting (Brusven et al. 1974). Once the insects are stranded, *desiccation*, adverse temperatures, and oxygen depletion associated with prolonged exposure of shorelines may cause a high mortality rate.

    If aquatic insect populations are seriously depleted, the recovery rate for fish populations following restoration of normal flows would probably be adversely affected.

3. Increased turbidity. Turbid waters originating in the reservoir can be expected to contribute to adverse survival conditions for aquatic organisms during reduced flows in the West Fork, influencing mortality rates among the aquatic insect populations and affecting the survival rate of fish.

    Among the major causes of aquatic insect mortality associated with sediment are: 1) the sediment's abrasive action, 2) the clogging of delicate external gill systems by suspended sediment, 3) egg mortality, and 4) the

smothering of relatively nonmotile forms by the deposition of sediment. The threat is greatest in rubble substrate, as that habitat is generally most productive for bottom organisms desirable as food sources for fish populations.

Most authors conclude that concentrations of suspended solids must be very high to cause direct mortality of fish; in most cases, indirect damage to the fish population through destruction of the food supply, eggs, or fry, or through changes in the habitat probably occur long before the adult fish are directly harmed (Elser and Marcoux 1971, Saunder and Smith 1965, Bianchi 1963). Of particular concern in the West Fork are populations of spawning mountain whitefish present in the river during the proposed time of action. It can be expected that the combination of high turbidity levels and reduced flows will adversely affect the spawning success of these populations.

4. Ice formation. The formation of *anchor ice* that may coat the bottom of the river during periods of reduced flows could contribute substantially to increased mortality of aquatic organisms, particularly insects (Brown et al. 1953). If conditions are extremely favorable for the formation of this type of ice, the entire reduced flow may freeze. Subsequent downstream movement of ice may affect fish populations and result in channel scouring if ice jams form during reduced flows.

5. Zero discharge. One of the alternatives being considered allows no discharge from the reservoir, which would severely affect the fishery of the West Fork by increasing stranding and entrapment mortalities and promoting deterioration of the exposed habitat. If productive habitat is exposed for long periods of time, desiccation and adverse temperatures may damage the *detrital base*, slowing the recovery rate of aquatic organisms following restoration of normal flows. The extent to which flows originating from seepage and tributary streams may temper the severity of these impacts is unknown.

Impact Summary. Regardless of the alternative method chosen for the proposed action, the fishery of Painted Rocks Lake and the West Fork will be adversely affected. Within the reservoir, displacement of fish downstream and entrapment in side basins can be expected to be the most adverse factors involved in the proposed action. Once the reservoir is allowed to refill, stocking with sport fish will be necessary to provide a sport fishery.

Downstream along the West Fork, stranding and entrapment resulting from the reduced flows will produce the greatest number of fish mortalities. Reduced flows, however, will cause not only direct mortalities, but also will influence the fishery recovery

rate. Factors such as increased turbidity, ice formation, and substrate exposure may result in serious damage to the basic productivity of the stream, delaying a rapid recovery of the fishery. Extreme flow reductions or zero discharge for the duration of the project would slow the regenerative ability of the West Fork, possibly requiring at least a full four-season cycle to reestablish its pre-project productivity.

IMPACTS TO THE CULTURAL ENVIRONMENT

Impacts on Land Use

Ownership. No impact is expected upon ownership.

Woodland. No impact is expected upon woodland.

Agriculture. Disruption of hay and gardening irrigation will be minimal, since the repairs are scheduled for the winter. Downstream tributaries will supplement the reduced flow, providing adequate water for stock water use.

Recreation. The quality of fishing will be reduced during the repair period. Only those fishermen seeking whitefish on the West Fork or trout in the reservoir during the winter months will be affected. A determination has not yet been made regarding impacts on ice fishing because of the reservoir drawdown. Some time-diminishing impacts will affect fishing quality for several months until fish populations are naturally or artificially restocked.

Other water-based recreational activities such as boating and canoeing will be reduced by draining of the reservoir. Associated activities like camping and picnicking will not be directly affected by the proposed action, but will generally be less desirable in the area because of the low storage and flows. Many of these activities are at an annual low during the winter months, which reduces the potential impact. Activities which are not water-based, such as hiking, hunting, and skiing, will be directly affected only by the aesthetic impact of reduced flows.

Impact on Locally Adopted Environmental Plans and Goals. The USFS released the Draft Environmental Impact Statement (EIS) for the Lower West Fork Planning Unit in November 1975. Several alternative plans for local management are currently being studied. No disruption to these USFS management plans is known.

Other local environmental goals are largely unassessed and will be addressed at greater length following formal reviewing processes and public input concerning this Draft EIS.

Impacts on Water Rights and Domestic Water Use

Ground-water levels will probably drop an unknown amount in

response to the reduced flows in the West Fork. In addition, the dam intercepts ground-water flow down the valley placing even more importance on streamflow to support ground-water levels. However, the following factors will reduce the effect of this project on ground-water levels:

1. the lowest water levels will occur during the winter months when ground-water withdrawals will be minimal;

2. the relatively short-term nature of the action will minimize effects. Ground-water flow rates commonly are measured at rates of feet/day, feet/week or slower. Water level declines should not become serious in a time period of only a few months;

3. leakage from the bedrock aquifer provides an unknown amount of water to the alluvial aquifer; and

4. small tributaries entering the West Fork between the dam and the Nez Perce will provide additional water to the aquifer.

The actual effect of the expected fluctuation of ground-water levels on an individual water right will depend on the elevation, location, depth, and static water level of each well. Valid water rights presently on file with DNRC will be honored, but water right holders involved must contact DNRC if they feel their water right will be affected.

Surface water rights should not be affected primarily because construction will be completed by the spring of 1977 before most diversions for irrigation. All water purchase contracts presently on file with DNRC will be honored.

Human Health and Safety

The repair action proposed is necessary to maintain continued safe operation of the dam. If uncorrected, cavitation will breach the seals of the gates, and control over flow through the outlet tunnel will be lost. If this happens, cavitation will increase the risk of dam failure. Peak spring inflow exceeds the capacity of the outlet tunnel, causing the reservoir to fill to the spillway even if the outlet tunnel is completely open. The risk of failure is greatest during full reservoir conditions reached every spring, because hydraulic pressure against the dam and cavitation in the outlet tunnel are highest at that time. A peak-flood failure would create substantial property damage and pose a significant risk of fatalities to downstream inhabitants.

Aesthetic Impacts

Negative aesthetic impacts will occur in the reservoir due to

the increased turbidity and the exposure of mudflats and unvegetated beaches during the reservoir drawdown. Low flow and turbidity in the stream below the dam will have a similar negative visual impact.

Although some fish kill is anticipated, no problem is expected from odors resulting from natural decomposition.

VI. RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Painted Rocks Lake, an artificial impoundment, has several constraints which a natural lake does not have. A major constraint, maintaining the integrity of the dam structure, precludes establishment of conditions beneficial to the reservoir's long-term productivity. Drawdowns similar to the proposed action have occurred at irregular intervals in the past and will be necessary every five years to meet safety inspection standards. Each of these short-term actions has prevented and will continue to prevent the reservoir from attaining its optimal productive potential as a self-sustaining sport fishery. Hence, periodic stocking will probably continue to be necessary to provide a sport fishery, regardless of the influence of the proposed action on the productive potential of the reservoir.

However, also to be considered is the effect of not conducting the proposed action. Should the repair project not occur and deterioration of the outlet tunnel continue, failure of the dam structure might ultimately result. Consequently, the proposed action may be considered beneficial by maintaining the integrity of the reservoir.

Similar limiting factors apply to the long-term productivity potential of the West Fork, since the river is directly dependent on the discharge from the reservoir for much of its flow. Although the short-term immediate effect on productivity is expected to be significantly adverse, the long-term influence should not be significant.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Fish and aquatic insect mortalities resulting from the proposed action constitute an irretrievable loss. However, when normal streamflows are restored, stocking and natural regeneration will result in recovery of these populations.

When a practical alternative for repair is identified, materials, manpower, and fossil-fuel energy necessary to implement that action can be considered irreversibly committed. Materials include concrete, reinforcing steel, and steel plates used to restore the outlet tunnel. Amounts and costs of concrete and steel to be used are small in contrast to current availability of these resources. Commitment of manpower will depend on the renovation design, time permitted to complete work, and practical limitations in work space. Fossil fuels necessary to maintain transportation and electrical generation (for welding, pumping, and hoisting) will be irreversibly and irretrievably committed.

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The Missoulian
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The Northern Rockies Action
Group, Inc.
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Mr. Jack Iman
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Mrs. Jean A. Warren, Chairman
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Mr. John Vanisko, President
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Conservation Districts
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Deer Lodge, MT 59722

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University of Montana
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SE of Stevensville, MT 59870

Mr. Robert N. Helding
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Billings, MT 59102

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Dr. John Moreland
Trout Unlimited
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Environmental Information Center
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Associated Press
317 Allen
Box 178
Helena, MT 59601

United Press International
2021 11th Avenue
Washington Plaza Office Bldg.
Helena, MT 59601

Inter Mountain News
2301 Colonial Drive
Helena, MT 59601

Ravalli Republic Daily
232 Main
Hamilton, MT 59840

Mr. Jack C. Jones
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Private Individuals

Mrs. Don Milner
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Mr. Peter C. Pauly
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Star Route Residents
along West Fork Bitterroot
River
Darby, MT 59829

X. APPENDIX A

NPSEN-PL-WC

24 November 1975

REPORT ON INSPECTION RELATED TO CAVITATION DAMAGE OF THE OUTLET TUNNEL AT PAINTED ROCKS DAM

1. General. On 12 November 1975, I inspected the outlet tunnel at Painted Rocks Dam in the company of Messrs. Bob Clark and Alex Bailey, employees of the Montana Department of Natural Resources. This inspection was confined to the portion of the outlet tunnel between the exit and the service gate. Painted Rocks Dam, located on the West Fork of the Bitterroot River near Conner, Montana, is owned by the State of Montana and operated by the Department of Natural Resources.

2. Observations.

a. Severe damage was observed throughout the transition area between the gate and the tunnel. Portions of the steel liner are missing and cavitation processes have removed concrete from the walls and floor up to 10 and 13 inches deep, respectively. The concrete in the floor of the tunnel near the transition has been completely removed to the foundation rock, and the cavitation processes are now attacking the rock. Open cavities between the concrete of the tunnel floor and the foundation rock were noted. Mr. Bailey stated he previously had inserted a steel tape into one of these cavities for a distance of approximately 13 feet.

b. Surface cavitation damage exists throughout the tunnel downstream from the major damage area. This damage is especially noted on both walls in a horizontal band approximately a foot wide located about 5 feet up from the floor, and on the entire right bank wall at the horizontal bend in the tunnel. The surface damage to the floor may be more the result of erosion than cavitation, although both the walls and floor have an "exposed aggregate like" surface.

c. The 6-inch diameter vent pipe and the area above the water surface in the tunnel are the only passages available to supply the aeration demand. These passages are severely restricted--the vent pipe by its extremely small size and the crown of the tunnel by the hydraulic action resulting from the baffle at the tunnel exit. The baffle forces a pseudo hydraulic jump in the tunnel which results in surging and spray filling the tunnel for all except extremely low flows. The filling of the tunnel effectively blocks the flow of air.

d. Mr. Bailey stated that lately they have been having problems sealing and unsealing the service gate. He thought this might be attributed to the new rollers that have been installed on the gate.

Incl 1

3. Discussions.

a. The transition area was previously repaired and restored to the "as designed" shape. The repaired outlet was only operated through 1 year before the present damage was found. This would indicate that the design of the flow surfaces is incorrect due to the abrupt changes in the continuity of these surfaces, and that the flow is denied aeration due to inadequate air vents. With this design, damage will occur any time significant discharges are made through the tunnel.

b. The recent change in operation of the outlet from a low flow outlet to a flood control outlet has resulted in discharges on the order of ten times those previously occurring, explaining the recurring damage to the structure which, prior to the operation change, appeared to be problem free.

c. The damage has progressed to a state that repair is imperative and it is not practical to accomplish repairs that would return the outlet to the original design. In recent years, the Bureau of Reclamation has been successful in reducing the cavitation potential of tunnel flow to insignificant proportions by the addition of air injector devices which provide aeration to the entire perimeter of the flow. I believe that the abrupt offset flow aeration design, similar to that shown in figure 10 of reference 1, would reduce the cavitation potential significantly and permit essentially cavitation-free operation at all gate openings. Such a design concept would require a much larger air vent pipe. Preliminary air demand calculations show at least a 30-inch diameter vent is required, and that between 300 and 400 c.f.s. of air is required to satisfy the maximum aeration demand. These computations are based on data found in reference 2. This concept would require the removal of the baffle at the tunnel exit. Such a design should be verified by model studies although reference 1 does provide some design criteria.

d. An alternative to the abrupt offset concept would be to construct a smooth transition, allowing the flow to conform to the flow surfaces, similar to transitions discussed in reference 2. This concept would also require enlarging the air vent and removal of the baffle.

e. The damage to the flow surfaces of the tunnel is probably a secondary effect, triggered by the extreme discontinuities of the flow boundaries now existing in the damaged area. Epoxy grout patching and grinding of the damaged surfaces is required in order to reduce the self-perpetuating cavitation potential that now exists on the extremely rough surface.

f. The problem of sealing and unsealing the service gate may be attributed to the new rollers that have been installed on the gate, but it could also be attributed to movement of the gate frame and guides resulting from the large volume of the supporting structure that has been removed immediately downstream from the gate.

g. Procedures for accurately measuring movement in the gate frame should be established and measurements taken periodically during changes in pool elevation. Any unusual amount of movement or the inability to seal or unseal the gate should be countered with immediate emergency action as a blowout of the gate area could be imminent.

4. Recommendations.

a. The damage to the outlet works tunnel should be repaired as soon as possible, preferably prior to the 1976 spring runoff as filling of the pool will subject the outlet to significant stresses. Repairs should include:

(1) Increasing the air vent to at least 30-inch diameter and venting of this pipe to the outdoors.

(2) Reconstruction of the transition using either an abrupt offset flow aeration concept (reference 1) or a design that will allow the flow to conform to the surfaces (reference 2). In order to confirm the selected design, a model study is recommended.

(3) Patch the cavitation damage or reline the tunnel with epoxy material downstream of the transition in order to obtain a smooth boundary.

b. The following immediate action should be taken in the interim before the repairs can be accomplished:

(1) Removal of the baffle located at the tunnel exit to allow maximum venting along the crown of the tunnel.

(2) Allow only minimum releases through the outlet; suggest that no more than 50 c.f.s. be released and less if possible.

(3) Make periodic precision measurements of the gate frame area in order to determine if movement of the frame is occurring.

(4) Make periodic inspections and measurements of the cavitation damage in the transition area. Suggest that these inspections be made weekly.

RICHARD P. REGAN, P.E.
Hydraulic Engineer

References:

1. "Cavitation Control by Aeration of High Velocity Jets" by Glenn L. Beichly and Danny L. King, ASCE Journal of the Hydraulics Division, July 1975.

2. "Hydraulic Design of Reservoir Outlet Structures" - Corps of Engineers EM 1110-2-1620, 1 August 1963.

XI. APPENDIX B

WEST FORK BITTERROOT RIVER STREAMFLOW RECORDS

West Fork Bitterroot River, near Conner, Montana

Location: NW¼ Section 26, Township 1 South, Range 22 West, Ravalli County, 0.6 miles downstream from Painted Rocks Lake, 16 miles southwest of Conner.

Average Flow: 292 cfs*; 34 year record (April 1941 to current year)

YEAR**	INSTANTANEOUS MAXIMUM DISCHARGE (cfs)	MINIMUM DAILY FLOW (cfs)
1975	2470	40
1974	3380	3
1973	1620	79
1972	3230	1.1
1971	2780	108
1970	2550	92
1969	1990	104
1968	1650	95
1967	2490	57
1966	652	16
1965	2200	21
1964	3120	86
1963	1600	23
1962	1300	60
1961	1820	58
1960	2280	24
1959	2330	65
1958	2440	25
1957	2860	16
1956	3260	65
1955	2090	50
1954	1850	.6
1953	2390	.7
1952	1670	43
1951	2020	1.2
1950	1860	23
1949	2280	51
1948	3880	30
1947	4060	88
1946	1110	20
1945	1300	1.5
1944	832	6.0
1943	2290	9.8
1942	2490	1.7
1941	820	

* Cubic Feet Per Second (cfs) - a flow rate of 448 gallons per minute.

** All years are "Water Years," from October 1 through September 30.

XII. APPENDIX C

WATER USE ON THE WEST FORK BITTERROOT RIVER

TABLE C-1.--Filed ground-water appropriations along the West Fork Bitterroot River between Painted Rocks Dam and its confluence with the Nez Perce Fork.

Number	Location	Owner	Total Depth	Static Water Level*	Use	Yield in gpm**
1	1N21W30cac	Walker	47	7.	Domestic	24.
2	1N21W31bbc	Kosteczko	42	12.	Domestic	20.
3	1N21W31bc1	Lentz	44	25.	Domestic	10.
4	1N21W31bc2	Lentz	30	9.5	Domestic	10.
5	1S22W1cc	Johnson	43	20.	Domestic	18.
6	1S22W11caa	USFS	182	10.	Domestic	4.
7	1S22W23cdb1	Ritchey	8	6.	Domestic	1.
8	1S22W23cdb2	Ritchey	8	0.	Domestic	1.
9	1N22W25d	Chappin	40	4.	Domestic	50.
10	1N21W30cb	Rasmussen	120	85.	Domestic	.5
11	1N21W30cc	Roff	27	4.	Domestic	25.

Source: Records Section, Water Rights Bureau, Water Resources Division, DNRC.

*Distance to water below ground level as recorded on appropriation form or well log.
**Gallons per minute.

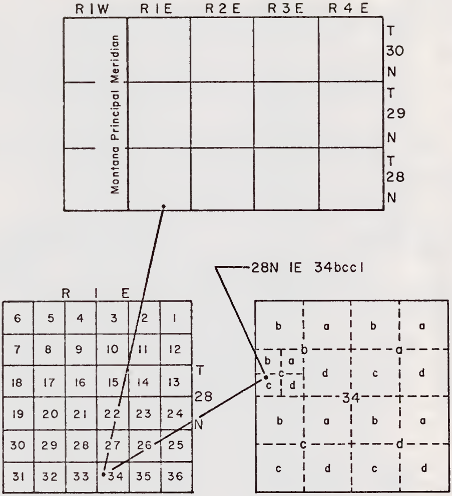


Figure C-1. Well-numbering system. The system indicates the locations of wells and springs within the official rectangular subdivision of the public lands of the United States. In Montana, all lands are referenced to the Montana Principal Meridian and base line. The first two segments of a number designate the township and range (28N 1E). The third segment gives the section number, followed by two or three letters (28N 1E 34bcc). Quarter sections are lettered a, b, c, and d, in counterclockwise order, from the northeast quarter of each section. Within each quarter section, the 40-acre tracts are labeled in the same manner, and the 40-acre tracts may be divided into 10-acre tracts in the same way. Thus, well 28N 1E 34bcc1 is in the SW¼ of the SW¼ of the NW¼ of Section 34, Township 28 North, Range 1 East, Montana Principal Meridian and base line, and is the first well visited in that tract.

Twp. 1 SOUTH
Rge. 22 WEST

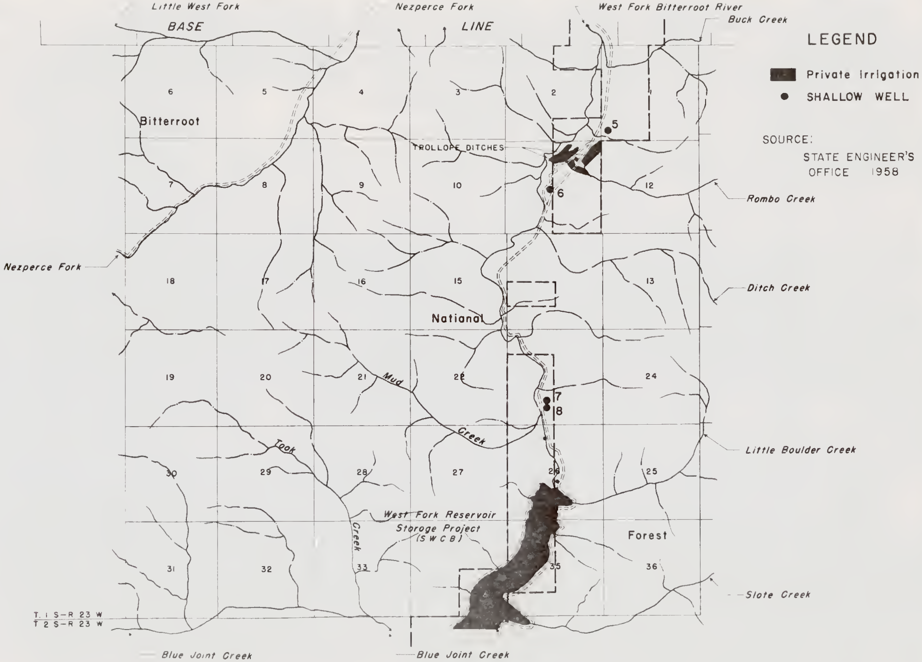
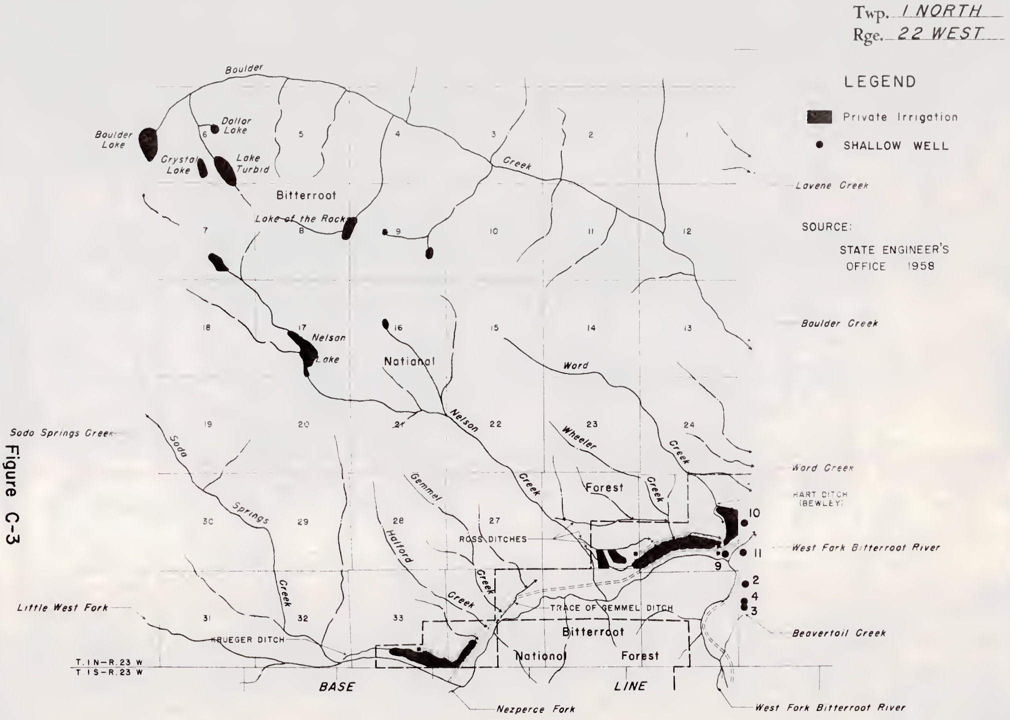


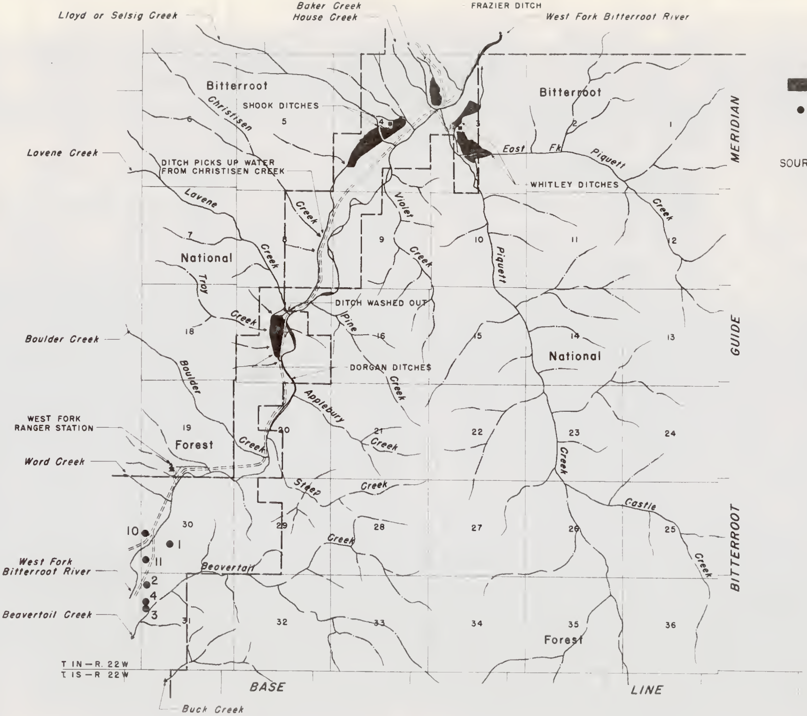
Figure C-2



Twp. 1 NORTH
Rge. 22 WEST
LEGEND
Private Irrigation
SHALLOW WELL
SOURCE:
STATE ENGINEER'S OFFICE 1958
Boulder Creek
Boulder Lake
Dollar Lake
Crystal Lake
Lake Turbid
Bitterroot
Lake of the Rock
Nelson Lake
National
Forest
Lavene Creek
Boulder Creek
Word Creek
Wheeler Creek
Nelson Creek
Soda Springs Creek
Sodo Springs Creek
Gemmel Creek
Halford Creek
Word Creek
HART DITCH (BEWLEY)
West Fork Bitterroot River
Beavertail Creek
ROSS DITCHES
TRACE OF GEMMEL DITCH
KRUEGER DITCH
Little West Fork
Bitterroot National Forest
T. I N - R. 23 W
T. I S - R. 23 W
BASE LINE
Nezperce Fork
West Fork Bitterroot River

Figure C-3

Twp. *1 NORTH*
Rge. *21 WEST*



LEGEND

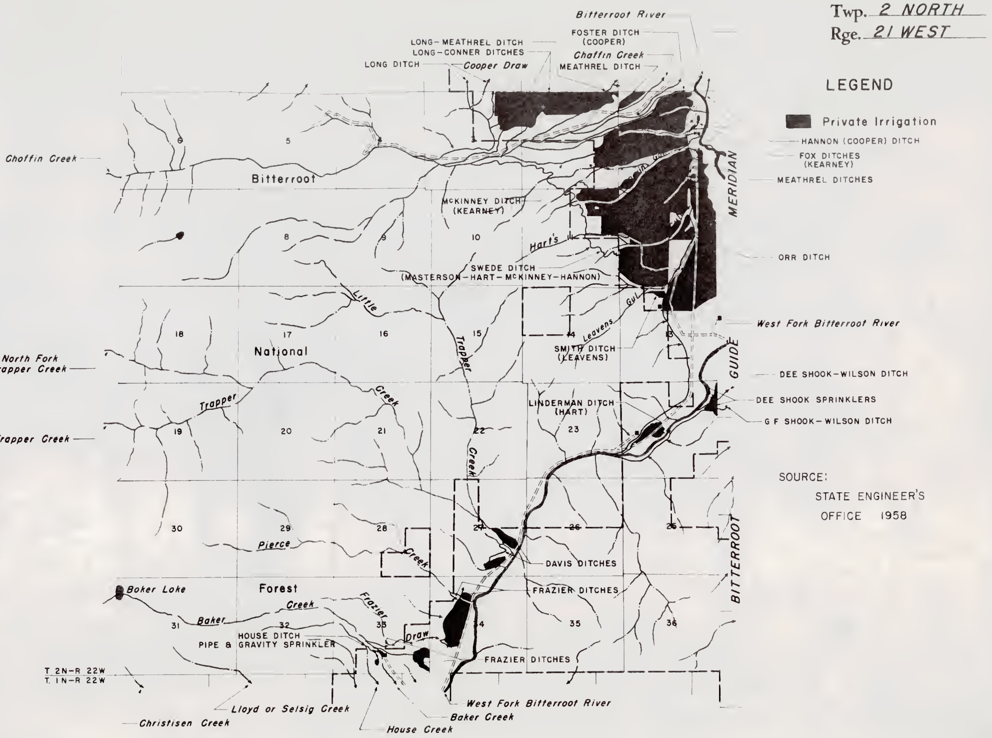
Private Irrigation

● SHALLOW WELL

SOURCE:

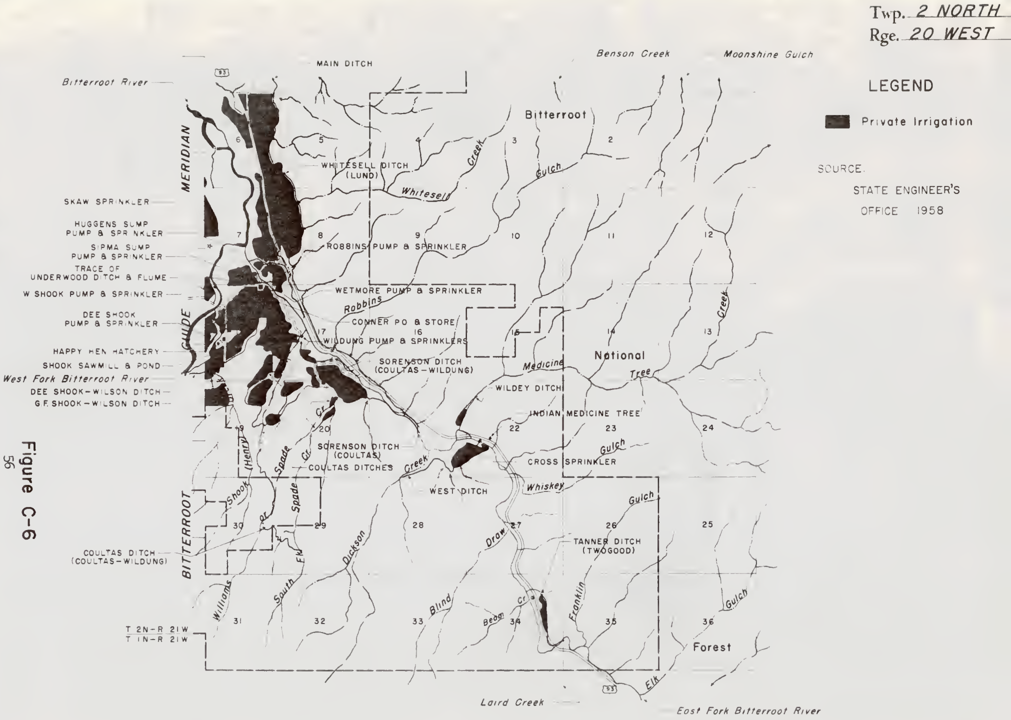
STATE ENGINEER'S OFFICE 1958

Figure C-4



Twp. 2 NORTH
Rge. 21 WEST
LEGEND
Private Irrigation
SOURCE:
STATE ENGINEER'S
OFFICE 1958
Bitterroot River
FOSTER DITCH
(COOPER)
LONG-MEATHREL DITCH
LONG-CONNER DITCHES
Chaffin Creek
LONG DITCH
Cooper Draw
MEATHREL DITCH
HANNON (COOPER) DITCH
FOX DITCHES
(KEARNEY)
MEATHREL DITCHES
Choffin Creek
Bitterroot
McKINNEY DITCH
(KEARNEY)
MERIDIAN
Hart's
ORR DITCH
SWEDE DITCH
(MASTERSON-HART-McKINNEY-HANNON)
Little
Leavens
West Fork Bitterroot River
North Fork
Trapper Creek
National
Trapper
SMITH DITCH
(LEAVENS)
GUIDE
DEE SHOOK-WILSON DITCH
Creek
LINDERMAN DITCH
(HART)
DEE SHOOK SPRINKLERS
G F SHOOK-WILSON DITCH
Trapper Creek
Trapper
Creek
Pierce
Creek
DAVIS DITCHES
BITTERROOT
Boker Loke
Forest
Creek
Frazier
FRAZIER DITCHES
Baker
HOUSE DITCH
PIPE & GRAVITY SPRINKLER
Draw
FRAZIER DITCHES
T 2N-R 22W
T. 1N-R 22W
Lloyd or Selsig Creek
West Fork Bitterroot River
Baker Creek
Christisen Creek
House Creek

Figure C-5



Twp. 2 NORTH
Rge. 20 WEST
LEGEND
Private Irrigation
SOURCE.
STATE ENGINEER'S
OFFICE 1958
Bitterroot River
MAIN DITCH
Benson Creek
Moonshine Gulch
Bitterroot
National
Forest
MERIDIAN
GUIDE
BITTERROOT
WHITESELL DITCH
(LUND)
Whitesell
Creek
Gulch
SKAW SPRINKLER
HUGGENS SUMP
PUMP & SPRINKLER
SIPMA SUMP
PUMP & SPRINKLER
TRACE OF
UNDERWOOD DITCH & FLUME
W SHOOK PUMP & SPRINKLER
DEE SHOOK
PUMP & SPRINKLER
HAPPY HEN HATCHERY
SHOOK SAWMILL & POND
West Fork Bitterroot River
DEE SHOOK-WILSON DITCH
G.F. SHOOK-WILSON DITCH
ROBBINS PUMP & SPRINKLER
WETMORE PUMP & SPRINKLER
Robbins
CONNER PO & STORE
WILDUNG PUMP & SPRINKLERS
SORENSON DITCH
(COULTAS-WILDUNG)
Medicine
Tree
Creek
WILDEY DITCH
INDIAN MEDICINE TREE
SORENSON DITCH
(COULTAS)
COULTAS DITCHES
Creek
WEST DITCH
CROSS SPRINKLER
Gulch
Whiskey
Gulch
TANNER DITCH
(TWOGOOD)
COULTAS DITCH
(COULTAS-WILDUNG)
(Henry)
Shook
Spade
Cr
Spade
Cr
South
Fk
Williams
Dickson
Drow
Blind
Bear
Cr
Franklin
Gulch
T 2N-R 21W
T 1N-R 21W
Laird Creek
Elk
East Fork Bitterroot River
93
6
5
4
3
2
1
7
8
9
10
11
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16
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Figure C-6

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XIII. GLOSSARY

Alkalinity: capacity of a water sample to neutralize acid.

Anchor ice: ice which forms on the bottoms of rapidly flowing streams. The thickness of the ice is determined by water depth, temperature, and velocity. Anchor ice will form when there is a sharp drop in air temperature below 32°F (0°C).

Dead storage: the volume of a reservoir which is below the lowest level of the outlet tunnel and thus cannot be emptied by gravity.

Desiccation: to dry out, such as when reduced flows in a river uncover areas of shoreline for prolonged periods.

Detrital base: finely divided material resulting from the decomposition of plants and animals. Detritus is an important food source for most aquatic insects and some fish species.

Dissolved oxygen: an indicator of the biochemical condition of the water at that time and place. The ability of oxygen to dissolve in water is primarily a function of temperature and pressure and is expressed in terms of actual concentration or as a percentage of saturation.

Food chain: a group of organisms dependent in a progressional order upon one another as a vital food source, the highest organism ultimately linked to the lowest organism. Example: fish--aquatic insects--detritus.

Habitat: an area that provides conditions and materials essential for the continued well-being and perpetuation of an organism.

Hardness: a measure of the amount of dissolved chemicals, chiefly calcium and magnesium, in a water sample. Low concentrations of calcium and magnesium indicate "soft" water, while water with high amounts is "hard".

Igneous: any rock which was once molten.

Metamorphic: any rock which has been altered from its original state by pressure, heat, and water, resulting in a more compact and more highly crystalline condition.

Spalling: fragmenting of concrete, usually in the shape of a flake, which is detached from a larger mass by the action of weather, by pressure, or by expansion within the larger mass.

Specific conductance: a measure of the water's ability to conduct an electrical current and a function of the amount and type of chemicals in solution.

Thermal stratification: the formation within a lake of distinct water layers with different temperatures. This stratification occurs during the summer and less frequently, during the winter. It is broken up in the fall and spring when turnover or mixing of the layers occurs.

Total dissolved solids: the sum of all chemicals and other materials in a water sample.

Transition area: passing from one size dimension to another. In the case of the outlet tunnel, a transition area is necessary from the rectangular gate to the circular tunnel.

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